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ABSTRACT

A study investigating the independence of linguistic abilities from each other, specifically the separability of syntax and semantics and the autonomy of syntactic abilities, is described. In the study, 30 individuals with Alzheimer's disease produced spontaneous conversations, completed sentences eliciting 16 grammatical forms, and when possible, wrote homophones dictated to them. Results showed consistently intact syntactic ability alongside marked deficits in semantic abilities across the three distinct task types. In addition, where it was possible to gauge pragmatic skills, it was found that certain conversational skills such as turn-taking and use of social interaction formulas remained intact while others such as topic maintenance showed significant impairment. This is consistent with research on aphasia showing behavioral and neuropsychological independence of language components. It is concluded that syntactic processes are an autonomous neuropsychological ability separate from lexical functioning in language production. Further research is under way on the preservation of syntax and semantics. (MSE)

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SELECTIVE PRESERVATION OF SYNTAX IN ALZHEIMER'S DEMENTIA

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Boston, 1983

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INTRODUCTION

During the past 10 years researchers have begun to investigate the language losses associated with the diffuse cortical atrophy and intellectual deterioration seen in various dementias, particularly senile dementia of the Alzheimer type. Research on this topic has had 2 main goals: first to describe and classify the type of language disorder found in Alzheimer's dementia, thereby distinguishing it from other language disorders associated with cerebral pathology, and second, to investigate what the Alzheimer pattern of language disorder can tell us about theories of normal language functioning. Our particular concerns center around the issue of the independence of various linguistic abilities from each other, specifically the potential separability of syntax and semantics. We hope to shed some light on the extent to which syntactic abilities are "autonomous"; what it means to say they are "autonomous" in the adult; and what exactly they may be "autonomous" from.

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There appears to be a consistent pattern of language loss associated with Alzheimer's dementia. A language disorder in dementia has been demonstrated by many different researchers and clinicians using a variety of measures. Word-fluency (word-list generation) appears to be particularly disturbed, as do reading for comprehension and narrative writing. Naming is often compromised and both lexical and sentential comprehension may be impaired. Perhaps the most ubiquitous finding, although the most difficult to test and quantify, is the appearance of "empty" speech, that is, speech

conveying little propositional content, exemplified by the presence of proforms for specific verbs and nouns (Bayles, 1979; Obler, 1983; Kempler, forthcoming).

In contrast, however, several language abilities remain undisturbed in this population. Productive fluency (including phonology, morphology, and syntax) and repetition, for example, remain largely intact (ibid.).

Based on this thumbnail sketch, this syndrome of deficits has been most often classified as (or compared with) transcortical sensory aphasia, an aphasia generally reported to involve intact repetition, fluent output and poor comprehension. (Appel, Kertesz, and Fisman, 1982).

Having described the linguistic profile we are dealing with in Alzheimer type dementia, interesting linguistic and neuropsychological problems begin to present themselves. For instance, how can a syndrome of language loss associated with diffuse cerebral damage as seen in this type of dementia mimic so closely a fluent aphasia like that associated with (posterior) focal damage? Another issue which has received considerable attention, and the one we wish to address today, is the extent to which preserved "fluency" in this population really represents an isolation of grammatical function. If grammatical function (including phonology, morphology and syntax) is selectively preserved, then we can argue that these abilities are neuropsychologically autonomous from the many other abilities which are generally impaired in this population.

Two seminal case studies have addressed this issue. In 1976 Haiganoosh Whitaker reported on a demented patient whose communication was limited to echolalia, but who spontaneously corrected ungrammatical sentences in her repetitions of them. This was taken to suggest the existence of a grammatical "filter" which operates separately from propositional or communicative abilities. A second study, a longitudinal case study by

Schwartz, Marin and Saffran (1979), investigated the preservation of grammar in a more intact dementing patient, who was able to name, point, attend and follow simple instructions. Schwartz et al were able to demonstrate severely impaired lexical knowledge alongside strikingly intact grammatical ability. Tests of auditory comprehension, speech production and writing were all used to demonstrate this finding.

This full dissociation between grammar and lexical semantics is remarkable for several reasons. First, it distinguishes Alzheimer type dementia from its first cousin, transcortical sensory aphasia, in that transcortical sensory aphasics have classically poor comprehension, at least in so far as it can be assessed. Secondly, it reifies a theoretical distinction in linguistics between components of the grammar: the computational components (syntax, morphology and phonology) vs. the semantic system. Replicating these findings with larger populations is important both for classification of the "aphasia" of dementia and for neurolinguistic and linguistic models of language function.

In the last few years several population studies of Alzheimer type dementia have appeared (e.g., Bayles, 1979; 1982; Appel, Kertesz, and Fisman, 1982), and to some extent they have upheld the generalization: dements demonstrate relatively well-preserved productive grammar in the context of impaired semantics.

However the population studies have not used comparable tasks in comparing the relative impairment in grammar vs. semantics. For instance, fluency (grammatical production) is most often judged subjectively from a spontaneous speech sample (WAB, BOSTON), while semantic ability is evaluated by structured tasks of naming and auditory comprehension. None of the population studies have systematically evaluated grammar and semantics within a specific context (i.e., either spontaneous conversation, elicited

speech, or comparable comprehension tests). They generally compare data from one context with data from another (e.g., reading comprehension with production in spontaneous conversation). This methodological weakness may be of special concern with a dementia population since dements uniformly have considerable attentional and immediate memory difficulties. Since it is sometimes very difficult for dementing individuals to stay on task from moment to moment when a structured task is involved, more structured tasks may yield different results than less structured tasks.

In order to accurately compare the extent to which semantics and syntax are differentially impaired or preserved, syntactic and semantic ability within a single task should be contrasted. In addition, results for both syntax and semantics across tasks must be compared to see if there is any interaction between task and performance in either of the domains of interest. Our study was designed to make these comparisons.

We used three different production tasks, each one requiring use of both grammatical and semantic knowledge. With the results of these tasks, we can directly compare grammatical vs. semantic performance within and across tasks.

SUBJECTS

Our subject population consisted of 30 individuals diagnosed as having an Alzheimer type dementia. The behavioral criteria to be used in diagnosing Alzheimer type dementias is a controversial issue. Criteria used in our study included impairment on a neuropsychological battery, particularly memory and visuo-spatial deficits, alongside the absence of motor or reflex changes. CVAs, Parkinsonism, AGS, Alcholic dementia and multi-infarct dementia were ruled out to the extent possible.

METHODS AND RESULTS

The 3 production tasks we used were (1) spontaneous conversation, (2) an elicited sentence completion task, and (3) a writing task.

In the first task, spontaneous conversations were tape-recorded on a Craig Electronic Notebook. The were then transcribed and analyzed. Topics of conversation included family, profession, personal history and questions from a neuropscyhological interview. The data from 8 subjects were analyzed and used for this report; a total of 922 utterances were included for the analysis of pragmatic skills; 848 utterances were included for the analysis of syntax and semantics. The difference in number of utterances is due to the exclusion of single word ("yes", "no") and unanalyzed (e.g., "I don't know") utterances for analysis of grammatical structure and semantic content.

The goal of our analyses was to tally the number of clear errors in each of three major coding categories: syntax, semantics and pragmatics, and statistically compare the error rate. Ideally, this would be a percentage of "possible" errors within each category. However, it is very difficult, if not impossible, to identify each place an error could have been committed, particularly in semantics and pragmatics. For the statistical analysis, then, actual number of errors were used for comparisons. In addition, mean error percentage rates have been given on the table in the handout. For the writing and the elicitation task, these percentages are based on the total number of items; for the spontaneous speech the percentages are based on the total number of utterances used in the analysis.

The grammatical analysis included a tally of sentence-internal errors of word-order, sentence structure, and noun and verb morphology. Our subjects demonstrated largely intact control of the grammar in these spontaneous conversations - only 17 clearly grammatical errors were made in

a total of 848 utterances. In addition, a wide range of complex sentences were present, suggesting that a normal range of syntactic operations is available to this population. In short, these patients uniformly exhibited well-formed and elaborate grammatical production.

In contrast, semantic analyses revealed clear and pervasive deficits. For the statistical comparison only errors of lexical choice were tabulated. A total of 116 lexical choice errors were made. These generally consisted of the substitution of a word that preserved form class and might be related in meaning as well to the target word. Errors in argument structure were also made, but many such errors appear to be missing objects which generally occured when the subject just "stopped" talking, possibly forgetting what he/she was saying. Because of the unclear nature of these errors, they were not included in the statistical analysis.

Expressive lexical problems were also reflected by 2 other error categories. First, abundant use of empty or vague words (particularly indefinites, along with filler words like "stuff", "places", and "do") were common and often made sentence interpretation difficult. Second, uninterpretable anaphoric and deictic terms were also numerous. These consisted primarily of pronouns with no identifiable antecedents, and deictic terms with no clear points of reference. Tallies of these errors, although they appear on your handout, were not included in the statistical analysis used to compare syntactic and semantic errors because they did not result in clear-cut lexical errors, but instead resulted in vague or uninterpretable speech. The anaphoric and deictic errors, in particular, may very well reflect problems with pragmatic awareness and memory impairments, neither of which did we consider strictly "semantic" deficits.

Our pragmatic analyses show that the demented conversations contained the full range of speech act types (with absence of directives, probably due

to data collection context), and appropriate use of social interaction devices including turn-taking, discourse particles and social interaction formulas. Noticeable areas of deficits, however, included frequent use of sentences which were uninterpretable or contribute little or no information (103), and frequent sentences which were topically inappropriate (68). See your handout for examples. In addition, although the data were not included in this analysis, we found that patients generally responded when questions were asked. However, their answers were often unsatisfactory, either because they were incomplete, did not directly answer the question, or were irrelevant.

The handout gives you examples of the major error-types we found in each of the 3 categories we coded. The raw numbers (those in parentheses) and the mean error percentages in the table sum up our findings: there were significantly fewer grammatical errors than either semantic or conversational errors, even when the most conservative estimate of conversational/semantic errors is used -- that is, excluding unclear pronominal and deictic references and "empty" words, all of which severely impair interpretability. Therefore, although the 14% you find in the semantic and pragmatic columns implies that an average of 86% of their utterances were interpretable, this is an overestimation of the number of interpretable utterances since this figure does not include errors in reference, or reflect the excessive vagueness due to "empty" words.

Another finding which is not apparent from the table is the degree to which the quality of spontaneous speech changes with the progression of the disease. Our subject population ranged from mild to severe cases and we found, as expected, that language disturbances increase as the disease progresses. More interestingly, however, this disintegration is reflected most strongly in the pragmatic/semantic phenomena not included in our

statistical comparisons: unclear deictic and pronominal references and empty words. Thus, as the disease progresses, the dissociation between preserved grammatical ability and impaired communicative ability in spontaneous speech becomes more and more striking.

The second task was an elicited sentence completion task. It is designed to elicit 16 different grammatical forms, twice each. The subject is read a sentence frame, and asked to complete it. Pictures accompany each item to aid in presentation and limit the load on auditory memory and auditory comprehension.

A sample item along with target and example error responses are on the handout. A subject's performance was scored for 3 types of errors: grammatical, semantic, and pragmatic. Examples of grammatical errors are omission of grammatical markers, non-concord of dependent tenses in conditionals, or errors in person-number agreement. Examples of semantic errors include responses which do not match the picture ("he is still eating", when in fact he has already finished eating) and lexical misuses (drank /poured). Examples of pragmatic errors include uninterpretable responses, and off-task responses such as changing the subject or commenting on the picture rather than completing the sentence.

The number of errors of each type were totalled for all subjects and are given after the examples on the handout. Only sixteen of our 30 subjects were able to complete the elicitation task. Mean number of grammatical and pragmatic errors both = 2.6; mean number of semantic errors = 5.8; As with the analysis of spontaneous speech, there were significantly more semantic errors than grammatical errors. But unlike the spontaneous speech analysis, the error rate for grammar and pragmatics was identical.

The third task was the writing of homophones. This task was adapted from a test developed and discussed by Schwartz, Marin and Saffran in their 1979 case study. In our adaptation, we dictate semantically related word-pairs and short syntactic phrases, each containing a homophone. The homophones are disambiguated by either a semantic cue (a closely related word as in look-see) or a syntactic cue (a grammatical functor as in 'the sea'). Each member of a homophone pair is presented with both a syntactic cue and a semantic cue. The number of errors with each type of cue is then tallied.

Of the 30 subjects, only 12 could be included in this portion of the analysis: of the remaining 18, some could not take the task at all (e.g., perseverating on name), responses of others were illegible or uninterpretable. Of the 12 whose data were included in the analysis, only 1 made more errors with the syntactic cues than with the semantic cues. A Statistical comparison of errors reveals significantly more errors using semantic cues than using grammatical cues. Mean percentage of each type of error is included in the table on the handout. In short, the patients were significantly less able to use the semantic cues than they were able to use the syntactic cues.

DISCUSSION AND CONCLUSIONS

To summarize our results, we found across three distinct task types a consistent demonstration of relatively intact syntactic ability alongside marked deficits in semantic abilities. In addition, where we have been able to guage pragmatic skills in this population, we have seen that certain conversational skills (e.g., turn taking, use of social interaction formulas) remain intact, while other skills (e.g., topic maintenance) show significant impairment.

We see our research as consistent with and strengthening the work on aphasia which has shown the behavioral and neuropsychological independence of different language components. In aphasia, selective deficits in syntactic processing have been reported for years. However, the logically opposite possibility of selectively preserved syntax has been difficult to demonstrate. Fluent aphasias present with "fluent" sounding speech, but syntactic ability beyond that has been nearly impossible to demonstrate. Frequent neologisms and general uninterpretability of fluent aphasics' speech makes their spontaneous production resistant to complete syntactic analysis. And severe lexical and comprehension deficits which generally accompany the fluent aphasias make other abilities (including syntactic comprehension) nearly impossible to assess.

Our work with Alzheimer type dementia has allowed us to more systematically investigate the selective preservation of syntax. We examined the expressive syntactic abilities of dements across 3 different production tasks, each demanding slightly different requirements, and consequently different degress of access to syntactic knowledge. In our patients, the ability to use syntactic knowledge was uniformly preserved (when compared with semantic abilities) across subjects and tasks. To the extent that we have demonstrated selectively intact syntactic abilities, we can conclude that syntactic processes constitute an autonomous neuropsychological ability demonstrably separate from lexical functioning, at least in production abilties. As a next step, we are now investigating the extent to which syntax is preserved in comprehension and which, if any, nonlinguistic abilities accompany the preservation of syntax. Additionally, we are investigating which abilities are impaired along with the semantic system. These data, we hope, will add to the arsenal of information available on the selectively preserved and selectively impaired abilities seen in language pathologies.

Before concluding, we would like to point out that finding and using Alzheimer's patients in research of this type is fraught with diagnostic and definitional difficulties. Identifying patients initially is difficult because different doctors use different names for essentially the same syndrome (OBS, PDD, SDAT, DAT). In addition, since the disease cannot be concusively diagnosed until postmortem, the diagnosis is often based on exclusion of known pathological processes. However, recently we see a move away from the rather unsystematic diagnosis-by-exclusion, towards the development of positive behavioral diagnostic criteria (e.g., Cummings, Benson and LoVerme, 1980). Towards this end, researchers have begun to identify deficits which are consistently involved in positive diagnoses of Alzheimer type dementias. Language is now widely acknowledged to be affected, at least by the moderate stage, and we are hopeful that our findings will aid in the efforts to use language as a reliable diagnostic criterion.

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Kempler/Curtiss
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ERRORS IN SPONTANEOUS SPEECH

1) Grammatical (total = 17):

- "Well, Mom and Dad is gone."
- "well, that doesn't seem to ___ very hard."

2) Semantic (total = 341):

A) Lexical (mis)choice (116):
-"yeah, 'cos we went to a trip near Alaska."
-"the water is wearin' off the sink."

B) Empty words (143)
-"Oh, no, if I have anything to do, I get something that has something doing or I have some reason for being."

C) Reference errors, including deixis, and pronoun use (132):
-"yeah, I said, well, "maybe he'll go down and take me to the ocean."

Examimer: "How are an orange and a banana alike?"
Patient: "Well, the banana and an orange are good friends."

Examiner: "How are a coat and a dress alike?"
Patient:"They could go out there and check it out."

3) Pragmatics (total = 171):

A) Topic relevance/maintenance (68):
Examiner: "How come you're here to see us?"
Patient: "My goodness, that's something I don't know."
Examiner: "Do you have any idea how come?"
Patient: "No, I don't if it's out for the day, and that's the way I always have mine. I have [something] at Easter, you know, and dress..."

B) Contributes new information/discourse progress (103):
-"And we stayed for six months in a house there that was a very ancient beautiful house. So we had quite a lot of things that were interesting. And we stayed there."

-"I was down there once with her just because it was interesting and she was taking me in her car and she was going to where she wanted to go, and if I was going, why I had to go where she was going. But it was interesting."

ELICITATION ERRORS

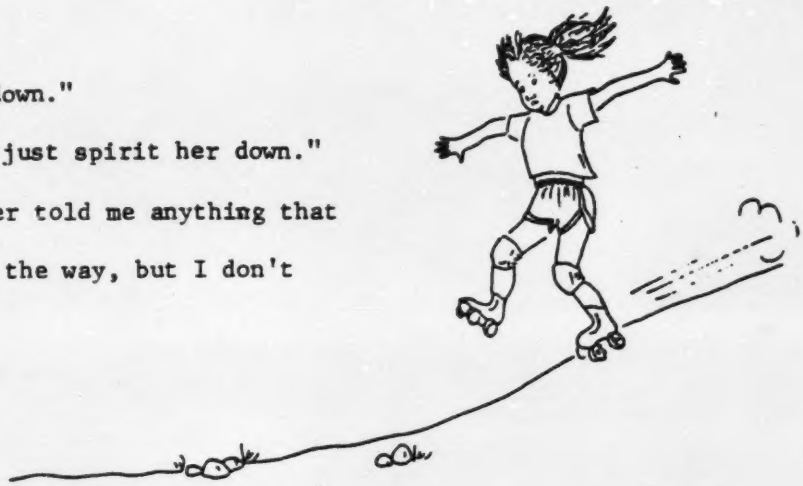
"This girl is skating too fast. If she skated any faster_____."
(she would fall; she'd get hurt)

Error responses:

Grammatical (42): "fall down."

Semantic (92): "it would just spirit her down."

Pragmatic (42): "she never told me anything that was here with her all the way, but I don't know what she did."



MEAN PERCENT ERRORS

	Syntax	Semantics	Pragmatics	significance levels for the difference between syntax & semantics
Spontaneous Speech	2%	14%	14%	$p < .01$
Elicitation	8%	16%	8%	$p < .05$
Homophones (writing)	13%	34%	------	$p < .01$